The other half of the picture: Post-occupancy evaluation for alignment of space and pedagogy

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Abstract: Prefabricated relocatable learning environments form an important component of school infrastructure in Australia but their light-weight construction means they often require air-conditioning for a comfortable indoor environment quality (IEQ). The ‘envi Sustainable Education Spaces’ were recently constructed by the Department of Education and Technology (DET) in Victoria to showcase a more sustainable alternative to the traditional ‘relocatables’. Evaluation had been undertaken by others to assess the design ambitions to reduce operational energy by 90% and lifecycle emissions of CO$_2$ production by 50%. What was not known was how the spaces accommodated learning and learners. This was the focus of research undertaken by the authors in 2014. In this paper, we present the methodology and findings and argue a case for holistic post-occupancy evaluation in order to paint a more complete picture regarding the costs and benefits of innovative spaces even when innovation is primarily focused on environmental benefits. The research applies a mixed methods approach, utilising quantitative and qualitative data. Commentary by students and staff on the indoor environment quality, including acoustics and temperature, provides useful cross-linking data with earlier studies. This research is part of broader research on prefabricated learning environments undertaken by the authors and others.

Keywords: Post-occupancy evaluation (POE), learning space evaluation, learning space design, mixed methods research.

1. Introduction

In 2014, the Department of Education in Victoria (DET) commissioned the Learning Environments Applied Research Network (LEaRN) at the University of Melbourne to undertake post-occupancy evaluation research of their recently completed ‘envi Sustainable Education Spaces’. The envi prefabricated education spaces had been designed and detailed with the aim of reducing operational energy by 90% and lifecycle CO$_2$ emissions by 50% from the standard prefabricated classrooms in circulation (DET, 2013). While an evaluation of the energy and CO$_2$ performance had been completed, what was not known was how the spaces performed for learning and learners. This LEaRN research addressed that question using a mixed methods approach in a three-phase data collection process. We
began with an online survey of key stakeholders and occupants of the facility including students, teachers and the principal. We then undertook an observational walk through the spaces with the principal and occupant teachers. The final stage consisted of a focus group at which the earlier findings and observations were reflected upon and opportunities for improvements were discussed. The data generated through this process can inform future designs but also, importantly, assists current users to better align space and pedagogy.

LEaRN’s School Spaces Evaluation Instrument (SSEI), Module Three—Alignment of Pedagogy and Learning Environments was utilised for this research commission. This instrument helps evaluate links between learning activities and the physical setting. It consists of three modules: Module One is focused on the design process; Module Two on the quality of the indoor environment; and Module Three considers the alignment of space and pedagogy. This instrument was developed by Cleveland as Research Fellow for LEaRN in collaboration with design and education academics at the University of Melbourne and industry partners including the Catholic Education Office (Melbourne), architecture firms and schools.

2. A critical review of the literature

The need for a more comprehensive Post-Occupancy Evaluation (POE) tool was established by a critical review of the literature related to learning space evaluation (Cleveland & Fisher, 2014). This literature review noted a recent spike in interest in learning environment evaluation at the intersection of the physical and the social using strategies which incorporated the opinions of the occupants and ‘called for two-way communication, community building, cooperation, trust and honesty’ (Preiser & Nasar, 2008, p. 88). However, strategies for the evaluation of pedagogical effectiveness are still in their infancy and there is a need for further work to ascertain appropriate methodologies (Lee, Tan, Learning, & Council, 2011; Pearhouse et al., 2009; Radcliffe, 2008). The literature review reveals that a number of research instruments have been developed in various countries to evaluate learning spaces however most share the shortcoming of focusing on the physical environment rather than how the learning spaces facilitate desired educational practices and behaviours. A difficulty with POE strategies is that they tend to be conceived from disciplinary rather than interdisciplinary perspectives.

There is a paucity of comprehensive building evaluation methodologies for all education sectors within the literature. In particular, there is little work available on formative evaluation methodologies that could not only support the evaluation of educational facilities but also help occupants better align pedagogy and space using a form of action research. Much research has focused on attempting to ascertain the causal links between space and learning outcomes, particularly within the United States (Higgins, Hall, Wall, Woolner, & McCaughey, 2005). The conclusion of Higgins et al’s review states that:

The evidence is unequivocal with regard to the importance of user engagement in defining and solving design problems in schools, and a necessary consequence of this is the realisation that design solutions will be individualised, organic and local. Indeed, the most successful are likely to be those which are seen as interim solutions and which have within them elements of flexibility and adaptability for new cohorts of learners and teachers, new curriculum demands and new challenges. (p. 37)

This observation highlights the need for design solutions to be perceived as organic and able to adapt to new cohorts. Likewise, a more recent literature review notes that there is ‘little empirical research that considers how students and teachers as well as communities negotiate and create new
relationships, organisational structures and processes in the use of new learning spaces’ (Blackmore, Bateman, Loughlin, O’Mara, & Aranda, 2011, p. 11).

The evaluation of buildings more generally was initially conducted in the 1960s by academics interested in the interaction between people and environment (Cooper, 2001). We consider this process as being post-occupancy evaluation (POE) defined as ‘the examination of the effectiveness for human users of occupied designed environments’ (Zimring & Reizenstein, 1980, p. 429). In the 1980s many post-occupancy evaluations were undertaken on public projects in the UK, USA, Canada, Australia and New Zealand (Preiser & Nasar, 2008). They were implemented differently in different countries and this led to a proliferation of POE methodologies (Hadjri & Crozier, 2009).

These were grouped into three categories by Crozier (2009): indicative, investigative and diagnostic. Indicative POE consists of quick walkthrough evaluations supplemented by structured interviews with key personnel as well as group meetings with building users. Investigative POE includes more in-depth analyses usually across a numbers of buildings of similar type. Diagnostic POE involves evaluating across a number of comparable facilities from a broad range of technological and anthropological perspectives (Cleveland & Fisher, 2014; Preiser & Nasar, 2008).

These POE processes do not focus on the transitional aspects of occupation highlighted above as being a specific concern for learning spaces. For example, the POE process was narrowly defined within the recent review of the Federal Government’s 2009 Building the Education Revolution (BER) to assess whether the policy funding had achieved value for money. The BER Taskforce focused its evaluation on quality, value for money, and on-time delivery. A critique of that methodology by one of the authors argued against the narrow definitions provided by the Taskforce on quality and value for money (Newton & Gan, 2012). The Taskforce focused on construction quality at the expense of design quality and was unable to assess the performance of the BER designs in terms of enabling learning. Likewise, value for money and on-time delivery were narrowly defined. For example, life-cycle costing was not included. In this research, we focus particularly on the evaluation of space in terms of occupation with an understanding that spaces and pedagogy should ideally be aligned.

3. The pros and cons of prefabricated learning environments

Before further elaborating on the research it is useful to understand the content of the envi learning space that was designed as a relocatable prefabricated building. Relocatable prefabricated learning environments are an important component of Australia’s school infrastructure. They usefully accommodate changing school enrolment numbers as the demographics of suburbs fluctuate. They also support remote community needs and accommodate students in times of disasters such as fires, floods and cyclones. In principle, they could be a sustainable and agile solution for changing needs but in reality they are not given the same design attention as permanent infrastructure. By the end of high school, students have spent around 15,000 hours at school (Rutter, Maughan, Mortimore, Ouston, & Smith, 1979). With relocatable classrooms accommodating up to thirty per cent of students in some states across Australia, the prefabricated learning spaces should be optimally designed and fit for purpose. For too long prefabricated buildings have not been given the same design attention as permanent buildings. Around Australia they are variously referred to as ‘relocatables’, ‘demountables’ and ‘transportables’ as well as ‘Mod 5’ or ‘Mod 10’ depending on their size and the number of modules used in construction. In the US and UK they are also called ‘modular classrooms’ and ‘terrapins’ which is the proprietary name of a UK manufacturer. The design of prefabricated learning environments was the subject of an earlier
research undertaking funded by the Australian Research Council Linkage Project called *Future Proofing Schools* and led by one of the authors. In an interview undertaken as part of that research, one teacher aptly said that ‘today’s relocatables fit a truck, not a learning experience’ (Future Proofing Schools research interview, April 2011).

As part of the Future Proofing Schools’ research project, stakeholders were asked what they would like for their learning spaces. The image below summarises their suggestions (Future Proofing Schools, 2011, p. 20). Perhaps unsurprisingly, the students’ responses were primarily linked to comfort while the educators focused on facilities and the principals on logistics and costs. We were interested to see if the same division of focus was found within the occupants of the ‘envi’ space.

![Image of suggestions](source: Future Proofing Schools, 2011)

Figure 1: What we’d really like. (source: Future Proofing Schools, 2011)
The ‘envi’ prefabricated prototype building contributes a new approach to prefabricated learning spaces. The ‘envi’ design includes strategies such as extra insulation to the external envelope, double-glazing, efficient lighting and automatic systems to monitor and operate the lighting, heating, cooling and ventilation of the indoor environment. The design improvements are largely focused on sustainability issues rather than considering how future learning might occur. The floor plan largely duplicates the common Victorian ‘Mod 5’ plans which typically consist of two classrooms linked partly by an operable wall and partly by a small retreat room.

Figure 2: Internal and external views of ‘envi’. (source: Author, 2014)
4. The research methodology

The research methodology recognises that the educational values of the school community and the administrative body should inform the learning evaluation. The evaluation is therefore intrinsically linked to the school’s context, its culture, educational philosophy and vision for learning.

A mixed-methods approach was used for data collection to ensure that the shortcomings of each individual method were overcome by the strengths of others and to triangulate across methods to support validity. Data was collected via surveys, structured observations and walkthroughs and a focus group presentation and discussion. In addition, photographs of the spaces in use were taken. A ‘walkthrough’ is an architectural observation method where an expert uses a checklist to evaluate the performance of specific spaces within a site. Walkthroughs are normally undertaken by architects during the defects liability period in order to discover faults or further work required to meet the contract delivery. In this study, we broaden the concept of the walkthrough to encompass how effectively the spaces are being used for learning. The researchers, as the ‘experts’ on space and pedagogy, conducted the walkthrough in partnership with three ‘informed participants’; the principal, a teacher and a representative of the infrastructure section of the education department. By sharing observations from the various perspectives of occupant, principal, bureaucrat and academic, our aim was to develop a more nuanced understanding of the strengths, shortcomings and missed opportunities in how the learning spaces were designed and occupied for learning and learners.

![Figure 3: Balancing pedagogy and space. (source: Cleveland, 2011)](image-url)

Researching the occupation of learning spaces is concurrently an opportunity and a dilemma because the research crosses the discipline boundaries between architecture and education. It is necessary to adopt and adapt research methodologies from both fields in order to make links between the policy and practice of education and the issues driving built environment design and practice.
research. Another important source of information was the surveys completed by the principal and assistant principal (50-60 minutes) and the follow-up focus group (60 minutes). The teachers identified by the principal as being the most knowledgeable about the spaces were invited to complete a shorter survey (20-25 minutes) as well as participating in the focus group (60 minutes). The quantitative data collected through the surveys was analysed using descriptive statistics, while the qualitative data was analysed using thematic narrative analysis (Riessman, 2008). The observational walkthrough and focus group data were also analysed using thematic narrative analysis.

Before commencing the in situ research, ethics approvals were applied for and granted by the host university and the administering education department. As part of the ethics approval, faces of teachers and students were required to be blurred to avoid identification in any published images.

The ‘envi’ building accommodated two traditional class groupings, each with a teacher and around 25 students. With permission from DET and the school principal, the researchers invited the teachers and students occupying the ‘envi’ spaces to participate in the study. The invitation to participate was supported by a written plain language statement and consent form. Primary students with signed permissions from their guardians or parents participated in a short online survey (15-20 minutes) and their answers and opinions form part of this analysis. Fourteen grade four students responded to the survey along with three teachers.

5. The findings

5.1. The vision for learning and teaching

The most successful schools tend to have a shared vision for teaching and learning which is well understood and able to be articulated by both staff and students. The interview with the principal for the ‘envi’ spaces summarised the school’s visions as being focused on:

- **Essential skills development**: literacy and numeracy, critical thinking and problem solving, and skills development for lifelong learning and community participation.
- **Teacher choice**: Teacher freedom to choose different tools, resources, settings and teaching approaches.
- **Shared teacher responsibility**: Collective ownership by teams of teachers for student learning across each year level based on a Professional Learning Community (PLC) model.
- **Measurable learning outcomes**: Goal-oriented learning supported by clear success criteria and data-driven teaching that is responsive to assessment feedback.
- **Timely interventions to support student-learning needs**: The school uses a carefully constructed timetable to allow year-level groups to work together for thirty minutes most days. This enables targeted cross-class teaching focused on individual student needs. Students are allocated into groups according to their learning needs for intensive teaching.

5.2. General findings

There was a high level of satisfaction with the ‘envi’ spaces when accommodating the traditional classroom practice of one teacher per class of students. The ‘envi’ building consists of two interlinked classrooms so there is some potential for teaching larger cohorts across the dual classrooms. The size of the space limits the occupants to around 56 students and the design restricts the movement of students and teachers to other indoor and outdoor learning settings. If the spaces were enlarged beyond the dual
classroom there would be further flexibility for the teachers to work more collaboratively in ways that would be better aligned with the education vision developed for this school. The evaluation highlighted the difficulties faced when modular facilities do not support collaborative practices that teachers and students may have developed in the permanent more flexible learning spaces.

Staff reported positively about the overall allocation of floor space when compared with the smaller classrooms in the permanent facility. In particular they appreciated the light-weight chairs and tables which were readily able to be reconfigured to suit different modes of learning. They also appreciated the pinup space and ramp access. Because of timber floors, lightweight relocatables are normally located above ground level requiring steps. Staff appreciated the withdrawal space shared by the two classrooms.

In terms of comfort, students and staff considered the indoor environment quality to be good for acoustics, natural and artificial lighting, temperature (when mechanical systems were operating normally) and air quality. Students commented on the noise of the automatically operating louvre systems.

The spaces could have been made more effective if they afforded greater flexibility to support a broader range of pedagogies and were more interconnected with other learning spaces to allow for greater collaboration. Access to more varied learning settings and furniture types, as well as a wet area construction zone, would help expand the modes of learning possible. The teacher workspaces located within each of the classrooms took up a substantial part of the footprint and these might have been more efficiently collocated to free up floor space and encourage teacher collaboration.

General access to outside areas for learning was limited even though a large deck adjoined the ‘envi’ space. A difficulty was the lack of visual access between the inside and the outside areas. Access to toilets was not easy, particularly in inclement weather. Best practice learning spaces tend to distribute toilets for easy access from teaching spaces rather than house them in blocks away from learners.

5.3. Suggested actions in response to the evaluation

There is an opportunity to further review the design and furnishing of modular buildings in ways that allow schools to have input into how the spaces are configured and furnished to more strongly link the spaces with the educational vision developed by the school. In this case, the school was keen for whole year levels to work collaboratively at times during the week to ensure students had access to explicit teaching to meet their needs. A ‘kit of parts’ approach may be suitable to enable facilities of various sizes and configurations to be created.

The ‘envi’ space is well suited to traditional classroom practice (single teacher model) but does not provide the flexibility required to support more collaborative practices and wet area activities. The potential for more collaboration in teaching and teacher preparation is limited to the dual classroom at this stage although there is potential for this building to be more closely linked across the decking to another dual classroom, particularly if the outdoor decking is rain protected.
6. Discussion

LEaRN’s SSEI tool is still evolving. It helps to highlight spatial possibilities and hindrances and also helps students and teachers to think constructively about space and reflect on their learning and teaching. In particular it begins to develop a spatial literacy in teachers to consider the physical environment as a third teacher.

Sometimes the quantitative responses raise issues that deserve further investigation. These formed part of the discussion within the focus group and during the observational walkthrough. Currently these do not include children and so even though we get useful qualitative data from their comments within the survey, we do not have the same rich overlay of qualitative data from students. For example, in the survey all teachers ‘strongly agreed’ they liked the views to the outside but over a third of the students did not like the views. We could surmise that the windowsill height works better for teachers who are predominantly standing but without further discussion we cannot be certain.

In earlier related research on prefabricated learning spaces we asked students, staff and principals open-ended questions about the types of learning spaces they would like. Students focused on comfort, educators on facilities and principals on logistics and costs. In this research we also asked students and teachers to highlight what they did and did not like about the ‘envi’ space. In this case, both groups focused primarily on comfort, with both groups also appreciating the furniture.

Even though the study was not focused on the environmental credentials of the space, there is a strong overlap between how the space works from an environmental perspective and how it works from a pedagogical perspective. Without prompting, over a third of students highlighted the noisy operation of the automatic ventilation louvres as a negative, saying ‘windows sometimes open and close and distract us with the noise’, ‘the windows are annoying, they are vey noisy’, ‘the windows sometimes get distracting with the noises when they open and close’, ‘the windows are noisy when they move’ and ‘the windows keep making a noise’. An explanation for this consistency may be that children are still developing the ability to block out extraneous noise. This kind of knowledge is useful for future designers of school spaces.

7. Conclusion

In this paper, we describe one application of a post-occupancy school evaluation instrument that uses a mixed methods approach to develop a more nuanced understanding of how space and pedagogy align. The application was commissioned by the Department of Education and Training in Victoria to better understand the learning and teaching implications of the ‘envi’ building where design innovation was focused on sustainability rather than teaching per se. Prefabricated learning spaces form a significant proportion of Australia’s school infrastructure and this research contributes to their ongoing improvement. The tool complements other post-occupancy strategies and highlights how design and space can support or hinder learning and teaching.
Acknowledgements

The authors acknowledge the Learning Environments Applied Research Network (LEaRN) based at the University of Melbourne. LEaRN is a collaboration between academia and industry partners including the Australian Science & Mathematics School, Catholic Education Office Melbourne, Churchie Grammar School, Hayball Architects, Indec-ARUP and Keepad Interactive. LEaRN research is part-funded by the Faculty of Architecture, Building and Planning, The Melbourne Graduate School of Education and the Faculty of Medicine, Dentistry and Health Services.

References


Author/s:
Newton, C; Cleveland, B

Title:
The other half of the picture: post-occupancy evaluation for alignment of space and pedagogy

Date:
2015-01-01

Citation:
Newton, C; Cleveland, B, The other half of the picture: post-occupancy evaluation for alignment of space and pedagogy, LIVING AND LEARNING: RESEARCH FOR A BETTER BUILT ENVIRONMENT, 2015, pp. 588 - 597

Persistent Link:
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File Description:
Accepted version